Code Jam 2022 - Round 1B

Controlled Inflation

Problem

The lines at the air pump at your gas station are getting too long! You want to optimize the process to help customers more quickly inflate their tires, sports balls, giant parade balloon animals, and other products.

The pump is automatic: you set the pressure to a specific number of pascals and plug the pump into the inflatable product, and it will inflate as needed to that exact pressure. There are only two buttons on the pump: up and down. They increase and decrease the target pressure, respectively, by exactly 1 pascal.

There is a line of $\mathbf{N}$ customers, each of whom brings exactly $\mathbf{P}$ products that they need to get inflated by the pump. You know the target pressure of each product. You can inflate the products from a customer in any order you want, but you cannot change the order of the customers. Specifically, you must inflate all products from the i-th customer before inflating any from the $(i+1)$-th customer. In between handling two products, if those two products have different target pressures, you need to use the buttons on the pump.

The pump is initially set to 0 pascals, and it can be left at any number after all products of all customers have been inflated. If you order the products of each customer optimally, what is the minimum number of button presses you need?

Input

The first line of the input gives the number of test cases, $\mathbf{T}$. $\mathbf{T}$ test cases follow. Each test case starts with a line containing two integers, $\mathbf{N}$ and $\mathbf{P}$: the number of customers and the number of products each customer brings, respectively. Then, $\mathbf{N}$ lines follow. The i-th of these lines contains $\mathbf{P}$ integers $\mathbf{X_{i,1}}, \mathbf{X_{i,2}}, \ldots, \mathbf{X_{i,P}}$, representing that the j-th product that the i-th customer brings has a target pressure of $\mathbf{X_{i,j}}$ pascals.

Output

For each test case, output one line containing `Case #`x`:` y, where x is the test case number (starting from 1) and y is the minimum number of button presses needed to inflate all products according to their specified pressures.

Limits

Time limit: 5 seconds.
Memory limit: 1 GB.

$1 \leq \mathbf{T} \leq 100$.
$1 \leq \mathbf{X_{i,j}} \leq 10^9$, for all i, j.

Test Set 1 (Visible Verdict)

$2 \leq \mathbf{N} \leq 10$.
$2 \leq \mathbf{P} \leq 3$.

Test Set 2 (Hidden Verdict)

$2 \leq \mathbf{N} \leq 1000$.
$2 \leq \mathbf{P} \leq 100$.

Sample

Sample Input

```
2
3 3
30 10 40
20 50 60
60 60 50
5 2
1 1000000000
500000000 1000000000
1 1000000000
500000000 1
1 1000000000
```

Sample Output

```
Case #1: 110
Case #2: 4999999996
```

In Sample Case #1, an optimal way to use the pump is:

1. press up 10 times, setting the pump to 10; pump the product (from customer 1) that needs 10 pascals,
2. press up 30 times, setting the pump to 40; pump the product (from customer 1) that needs 40 pascals,
3. press down 10 times, setting the pump to 30; pump the product (from customer 1) that needs 30 pascals,
4. press down 10 times, setting the pump to 20; pump the product (from customer 2) that needs 20 pascals,
5. press up 30 times, setting the pump to 50; pump the product (from customer 2) that needs 50 pascals,
6. press up 10 times, setting the pump to 60; pump the product (from customer 2) and the two products (from customer 3) that need 60 pascals, and finally
7. press down 10 times, setting the pump to 50; pump the product (from customer 3) that needs 50 pascals.

This is a total of 110 button presses.

In Sample Case #2, notice that the answer can be larger than 2^{32}.